



**A Two-Factor Uncertainty Model to Determine the Optimal Timing
for an Incumbent Manager to Venture as an Entrepreneur**

By

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Abstract: English

As the economic and social situation declines post US subprime and European Sovereign debt Crisis in Europe, especially in Portugal, public authorities have been largely ineffective in reviving the economy. Various rescue packages within EU by respective governments have failed to fulfil their purpose and the outlook for growth and employment remains subdued. The road to recovery needs to be reworked. A reenergized impetus is needed towards *Entrepreneurship* as we argue that it is equally, if not more important when the economy is doing badly. In this backdrop we have focussed our study on *Managers* for two primary reasons. First, they are better positioned to be successful in their venture owing to their experience and secondly their success in turn would inspire youths to take *Entrepreneurship* which in turn would benefit the economy at large. We study optimal moment for an incumbent *Manager* to move away from his current job and start his own venture following a *Real Options* approach. A two – factor uncertainty approach based on Adkins and Paxson (2011) is adopted.

Key words: *Entrepreneurship, Manager, Real Options, Economic Development*

Resumo: Português

Com o declínio da situação económica e social, provocado pela crise do *subprime* dos EUA e da dívida soberana na Europa, especialmente em Portugal, as autoridades públicas têm sido, na sua grande parte, ineficazes na revitalização da economia. Os vários pacotes de resgate adotados dentro da EU, pelos respetivos governos, não conseguiram cumprir o seu objetivo e as perspetivas para o crescimento e criação de emprego continuam bastante moderadas. O caminho para a recuperação necessita de ser reavaliado. Um revigorado ímpeto do Empreendedorismo é essencial, uma vez que argumentamos ser tão ou mais importante quando a situação da economia é particularmente má. Neste cenário, focamos o nosso estudo nos Gestores essencialmente por duas razões. Em primeiro lugar, estão melhor posicionados para ter sucesso no seu empreendimento devido à sua experiência, e em segundo lugar, mas não menos importante, o seu sucesso inspiraria jovens a seguir a rota do Empreendedorismo, o que por sua vez beneficiaria a economia no seu todo. Estudamos o momento ótimo para um gestor executivo deixar o seu trabalho atual e iniciar o seu próprio projeto, seguindo uma abordagem de Opções Reais. Foi adotada uma abordagem de incerteza de dois fatores Adkins and Paxson (2011).

Palavras Chave: *Empreendedorismo, Gestor, Opções Reais, Desenvolvimento Económico.*

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1. Introduction

The advent of US subprime crisis followed by European sovereign debt crisis had led to protracted economic downturn in the euro area with the sub-continent struggling in an uphill battle against the lingering effects of these crises, grappling in particular with the challenges of taking appropriate fiscal and monetary policy actions to stimulate the economy. The recovery has been largely falter as the governments struggle with austerity and attempts to regain competitiveness. Various rescue packages within EU by respective governments aimed at avoiding market panic and restoring investors' confidence have failed to fulfil their purpose and the outlook for growth and employment remains subdued and is marked by persistent cross country differences. EU figures suggest that around one-in-five young people in the EU were unemployed in 2011 whilst youth unemployment in countries such as Greece and Spain was over 40 per cent (Eurostat, 2011). In many OECD countries, youth unemployment is either at, or close to the maximum level, ever experienced (OECD, 2010)¹

Portugal was no exceptions and was one of the countries hit the hardest by Sovereign debt crisis. The government responded by implementing rescue plans by injecting capital, providing liquidity provisions and guarantees but began to face difficulties to refund their own debt starting the beginning of 2010. As a consequence in 2012 they have to take a \$105 billion bailout from the IMF that required the country to cut government spending and raise taxes. Owing to Government budget cuts in the run-up to Euro Crisis, Youth unemployment reached record highs with a rate of 37.7% (Eurostat, 2011). Also the public finance situation no longer allows for large scale stimulus policies, whilst any additional action on the part of the Government of Portugal would not be enough to jump-start the economy and create jobs. Public policies are in deadlock and the economy is stagnating and this is the cause of concern and discontent. And without jobs and growth, the European idea itself is in danger.

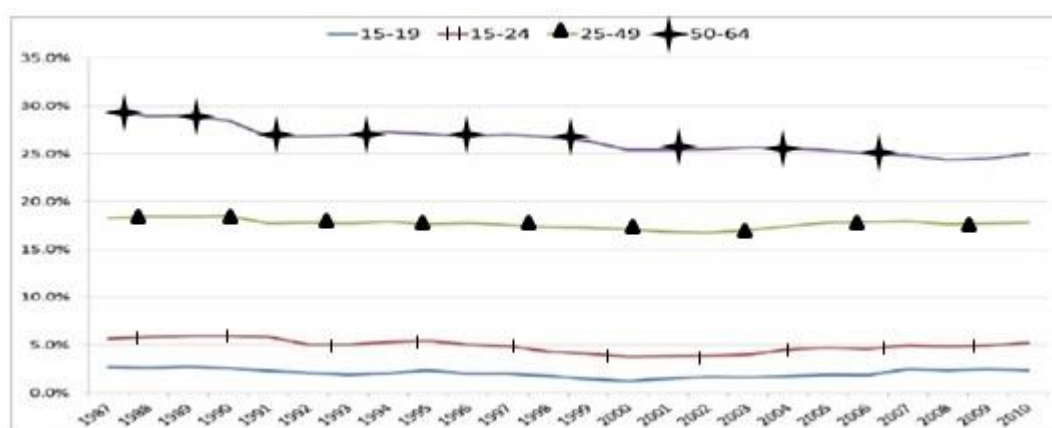
From the discussions above, it can be argued that as the economic and social situation declines in Europe and especially in Portugal, public authorities are becoming increasingly powerless. That being said the road to recovery needs to be reworked and hence we propose that a reenergized impetus is needed towards *Entrepreneurship*, very few of the time tested alternative to revive the economy. *Entrepreneurs* are equally, if not more, important when the

¹ Figures for 'maximum ever' are from 1985.

economy is doing badly. When unemployment is high and the economy is contracting or stagnating, dynamic *Entrepreneurship* could help turn the economy around.

Keeping these motivations in mind we have focus our study on most important facet across entire Business Industry, The decision Makers: The *Managers*. “Under what conditions it is optimal for incumbent *Managers* to part ways from their conventional jobs and venture into the world of *Entrepreneurship*”. We will try to explore the idea using *Real Options* approach. One of the prime motivation for selecting “*Managers*” as a central point of our study is the relatively small participation of youths in *Entrepreneurship* across EU. Figure 1 and Figure 2 present EU self-employment rates for males and females, respectively, by age over the period 1987-2010 (OECD, 2010). As per the survey, it could be seen that older rather than younger individuals are more likely to be self-employed. In Figure 1, older males (aged 50-64) are approximately five times more likely than younger people (aged 15-24) to be self-employed². But the Euro Flashbarometer (2011) of the OECD report indicates that about 40 per cent of young people would like to become an *Entrepreneur* signalling that there is a desire among youth to take *Entrepreneurship*.

Figure 1: EU Male self-employment rates by age, 1987-2011³.

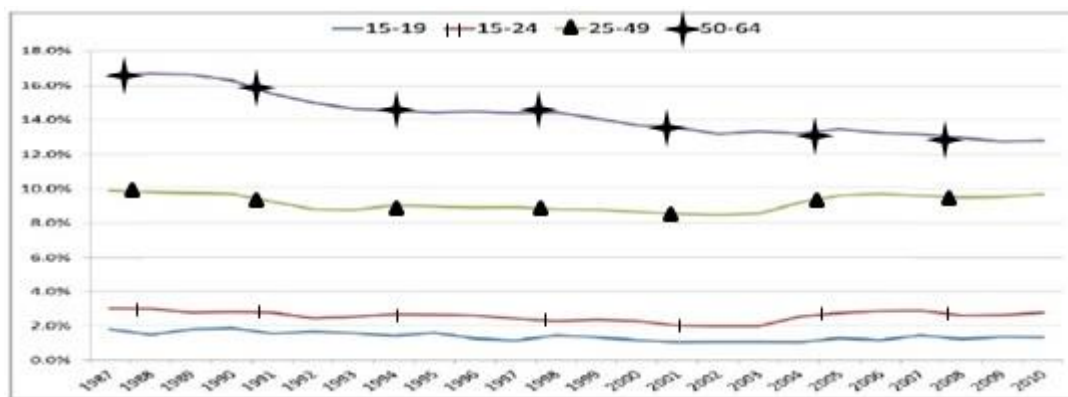


Source: Eurostat Labour Force Survey.

² This evidence is in contrast to studies that suggest that the relationship between age and self-employment rates follows an inverted U shape pattern with young and older people being less likely than ‘prime age’ individuals (aged 30-50) to be self-employed (Storey & Francis, 2010). This inverted U shape pattern is typically derived from the age and age squared (usually taken as a proxy for ‘experience’) of the individual and shows a positive sign for age but a negative sign for age squared. The relationship, however, between age and self-employment may be changing as there is increasing evidence that older people are much more likely to have taken up self-employed (Storey & Francis, 2010).

³ These figures are computed by dividing male self-employment by male employment. If the denominator is total population, the percentage of male self-employed amongst young males (15-24 year olds) is about 1 per cent across the period 1987-2010.

Figure 2: Figure 2: EU Female self-employment rates by age, 1987-2011.



Source: Eurostat Labour Force Survey.

So in this vain, an experienced *Manager* setting up a new business may provide demonstration of learning externalities, in that they may act as a role model for other young people. This may be particularly advantageous in current economic state because setting up a new business – especially if it goes on to be successful – may signal that *Entrepreneurship* is a potent alternative mechanism and appeal to the concerned parties. We believe such analysis has the potential to give incumbent *Managers* an extra impetus of certainty for them to make an informed shift towards *Entrepreneurship* should they wish to do so and eventually benefit society as a whole. Placing *Entrepreneurs* at the core of economic policy - this is an acknowledgement of their fundamental role in reviving growth.

Having said that the nature of the dissertation is theoretical and it is broadly structured into five main sections that build on each other. In Section 1 above, we have very briefly tried to present the current economic landscape across EU and Portugal in particular and motivations behind the questions we are trying to address in the dissertation. In section 2, rooted in Financial and Economics scientific literature, evidence of *Entrepreneurship* as economic growth driver is presented. The gap in the literature concerning application of *Real Options* towards *Entrepreneurial* venture is highlighted. Section 3 presents the model followed by a numerical example in Section 4. Finally, in section 5 we conclude and suggest some natural extensions to our model.

2. Literature Review

In this section we will briefly look at the most relevant literature concerning *Managers* and *Entrepreneurship* going side by side and role of *Real Options* as a decision making platform for the incumbent *Managers*.

2.1 Entrepreneurship and Economic Development

It has been widely recognized by scholars and policy makers in the USA and Europe, and much has been scripted on how *Entrepreneurs* can promote regional economic development (Nolan (2003), Audretsch D. (2009)) *Entrepreneurship* is ‘at the heart of national advantage’ (Porter, 1990). It offers an indigenous solution to a country’s economic problems (De Clercq & Honig, 2011).

Portugal’s *Entrepreneurial* renaissance could indeed spur an economic revival as any macroeconomic recovery requires either existing companies to grow or new ones to form – this is what creates jobs. The view is supported by Audretsch & Fritsch (2002) who in turn have argued that high levels of new firm formation should have a stronger impact on employment in the regions where existing firms are not growing optimally which happens to be the case broadly across Europe.

2.2 Entrepreneurship and Managers

Much has been written about independent *Entrepreneurship*, which refers to an individual or a group of individuals striking out on their own to start new business. A common theme running across the literature concerning the sustained success of their venture is their ability of continuously assimilate, process and update industry trends and knowledge in the pursuit to finding distinctive ways including newness, novelty or practicality to address commercially viable opportunities. New knowledge is developed through a process of learning, which is associated with experience that enhances performance (Foil & Lyles, 1985), (Huber, 1991).

Rooted in the evidence presented via above stated literature, we posit that given knowledge is at the heart of successful *Entrepreneurial* life cycle, *Managers* with their vast experience and industry know-how are best positioned to take up *Entrepreneurship* with greater chances of success, should they wish to do so. Executives with experience in an industry have detailed knowledge about how that industry operates or have faced issues pertinent to older or larger organizations, and thus their experience could be instrumental as the company grows (Eisenhardt & Schoonhoven, 1990), where majority of the start-ups fail.

With respect to *Entrepreneur's* entry timing, numerous measures of performance have been used in entry timing research, thus providing some guidance on what may influence the entry decision. These measures include profitability (e.g., Abell & Hammond (1979), Rothaermel (2001)), survival (e.g., Robinson & Min (2002)), market share (e.g., Szymanski, Troy & Bharadwaj (1995)), and multiple measures (e.g., Lambkin (1988), Mitchell (1991)). But most of these studies have followed the orthodox rules of investments for making the decision.

2.3 Real Options approach to Investments

The orthodox theory of investment however has not recognized the important qualitative and quantitative implication of interaction between irreversibility, uncertainty, and the choice of timing (Dixit & Pindyck, 1994). The "standard" Discounted Cash Flow (DCF) / Net Present Value (NPV) approach discounts future expected cash flows at a discount rate that reflects the embedded risk in the project while implicitly assuming investment decision to be "passive" with regard to their Capital Investment once committed. This method does not account for changes in risk over the project's lifecycle and hence fail to appropriately adapt the risk adjustments. It makes no provision for this flexibility of the project and consequently undervalues its benefits (Dixit & Pindyck, 1994).

By contrast, the *Real Options* approach posits that investment decisions ought to be treated "actively" and should "continuously" be adjusted for market changes (Dixit & Pindyck, 1994). It values flexibility considers each and every scenario and indicates the best action in any of the contingent events by adapting to negative outcomes by decreasing exposure and to positive scenarios by scaling up, henceforth benefiting from uncertainty and achieving a lower variability of returns than under the NPV stance (Trigeorgis, Brosch, & Smit, 2010). The contingent nature of future profits in real option models is captured by employing the

techniques developed for financial options in the literature on contingent claims analysis (Dixit & Pindyck, 1994).

The Real Options literature concerning *Managers* though has largely focussed on devising optimal compensation schemes to balance Agent-owner interests, optimal investment timings for incumbent firms under competition (see Cordoso & Pereira (2015), Pereira & Rodrigues (2014)) respectively for the latest findings). To the best of our knowledge there remains no literature that has addressed its application as decision aiding tool to move towards *Entrepreneurship* by an incumbent *Manager* or any prospective aspirant for that matter. The important point in our study is that the decision to enter is a one-shot action that cannot be completely withdrawn from if things go wrong. Thus, the entry contributes to an irreversible decision that does not have the characteristic of an updating process. The *Real Option* philosophy could help in addressing that.

Henceforth there remains a gap in the *Real Options* literature concerning *Managers* which have we tried to bridge in this dissertation. The advantage of this model is that it leaves enough flexibility to be incorporate more variables that could be varied stochastically and specific cases can be derived from the general solution, that, in principle, can be found analytically, and most importantly, that it paves the way for expanding the analytical scope for an incumbent *Manager* for making an informed switch towards Entrepreneurship or aspiring young minds in general.

3. Model Description

We begin by considering that multiple uncertainties surrounds an incumbent *Manager* while considering *Entrepreneurship* and starting his own venture. These myriad uncertainties are broadly consolidated into two sources. First, uncertainty regarding the future cash flow to be generated from *Entrepreneurial* venture and second the cash flow of the company where he is presently employed as the *Manager*. We represent the cash flow generated in present value terms by the *Entrepreneurial* Venture and the Company as V_E and V_C respectively.

We will follow Adkins & Paxson (2011) approach of quasi-analytical solutions based on a two-factor uncertainty model, consisting of a set of simultaneous equations considering the current benefits enjoyed by incumbent *Managers* (a fixed salary and variable benefits based on performance) and cash flow from the new business should the *Manager* decides to venture as an *Entrepreneur* as uncertain and varying stochastically. This will help us in determining the boundary separating the regions where the value of both variables justify an incumbent *Manager* to either continue with the current job or quit it and venture as an *Entrepreneur*. Given the fact that there is going to be a trade-off between the two stochastic variables and only when both triggers will simultaneously be attained at a given investment cost, *Manager* will make the decision to pursue *Entrepreneurship*, there is going to be a set of countless pairs for such triggers (Adkins & Paxson, 2011).

Hence, in our model, we are going to represent the above stated countless pair of threshold values for the stochastic variables as V_C^* and V_E^* and also that these pairs defines the discriminatory boundary (see Figure 3) that separates the waiting region from the switching region. Following Adkins & Paxson (2011), the value of the option to switch and move towards *Entrepreneurship* will depend on both variables, which means that the option will be exercised (i.e. the *Manager* will quit his job and venture as an *Entrepreneur*) when V_E becomes sufficiently high for a given V_C or V_C becomes sufficiently low for a given V_E , meaning the *Manager* would take *Entrepreneurship* when cash flows from the venture becomes much large from his current wealth from incumbent job. On the other hand, if V_E is not sufficiently large for a given V_C or V_C is not too low for a given V_E ; then the *Manager* will not exercise the option to make the switch and continue with his current job. Hence, there is going to an optimal boundary composed by a set of pairs for V_C and V_E which divides the region where the *Manager* will continue with his job from the region where he will make the

switch to *Entrepreneurship*. We are denoting these set of trigger values as $\{V_C^*, V_E^*\}$ and it is represented by the straight line in the graph below.

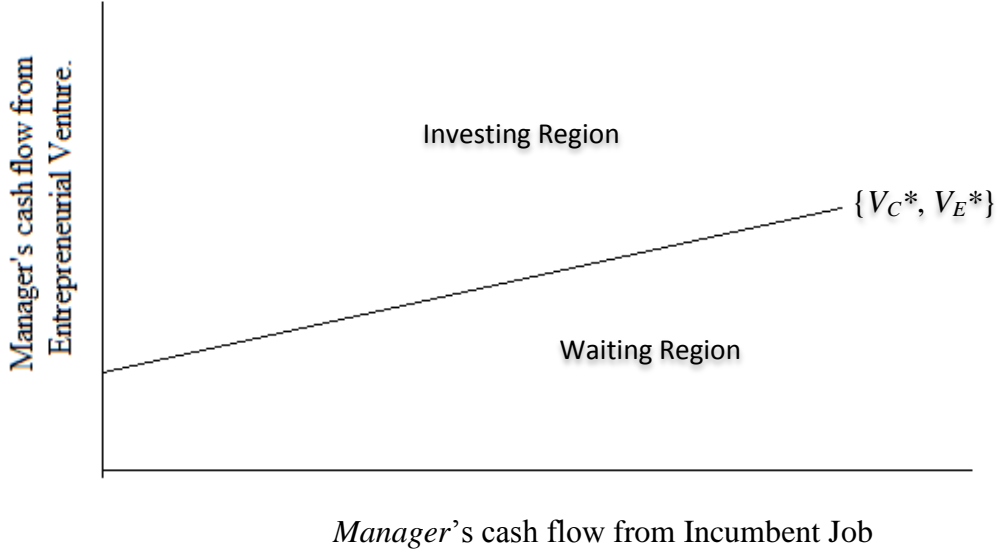


Figure 3: Incumbent Manager's discriminatory boundary.

Now that we have defined the setup, the two stochastic variables V_C and V_E follow geometric Brownian motion. The variables could be correlated.

So,

$$dV_C = \alpha_{V_C} V_C dt + \sigma_{V_C} V_C dz_{V_C} \quad (1)$$

$$dV_E = \alpha_{V_E} V_E dt + \sigma_{V_E} V_E dz_{V_E} \quad (2)$$

$$E (dz_{V_C} dz_{V_E}) = \rho dt \quad (3)$$

where α_{V_C} and α_{V_E} are instantaneous drift parameters, dt the time interval, σ_{V_C} and σ_{V_E} are instantaneous volatility rates for each of the variables with dz_{V_C} and dz_{V_E} being the corresponding increments of standard Wiener processes and ρ is the correlation coefficient between V_C and V_E .

Under risk-neutrality, we define the value function $F_M (V_C, V_E)$ as the value for *Manager's* wealth from his current job including the embedded switch (to *Entrepreneurship*) option and this must satisfy the following partial differential equation (Constantinides, 1978).

$$\begin{aligned} \frac{1}{2}\sigma_{V_C}^2 V_C^2 \frac{\partial^2 F_M}{\partial V_C^2} + \frac{1}{2}\sigma_{V_E}^2 V_E^2 \frac{\partial^2 F_M}{\partial V_E^2} + \rho\sigma_{V_C}\sigma_{V_E} V_C V_E \frac{\partial^2 F_M}{\partial V_C \partial V_E} + (r - \delta_{V_C})V_C \frac{\partial F_M}{\partial V_C} + \\ (r - \delta_{V_E})V_E \frac{\partial F_M}{\partial V_E} - rF_M + (rW + \varphi\delta_{V_C}V_C) = 0 \end{aligned} \quad (4)$$

Where r is risk-free rate of interest, $(rW + \varphi V_C \delta_{V_C})$ denotes *Manager's* annual compensation from incumbent job expressed as sum of a fixed component, W and percentage φ of the cash-flow generated by the company (where he is manger), $\delta_{V_C} V_C$, δ_{V_C} and δ_{V_E} denotes the dividend-yields for V_C and V_E and are given by following equations respectively:

$$\delta_{V_C} = r - \alpha_{V_C} \quad (5)$$

$$\delta_{V_E} = r - \alpha_{V_E} \quad (6)$$

Equation (4) has a non-homogeneous part, W and the rest of the equation is homogeneous. The following general solution satisfies the homogeneous part of the partial differential equation (4):

$$F_M^H(V_C, V_E) = A_1 V_C^{\beta^+} V_E^{\eta^+} + A_2 V_C^{\beta^+} V_E^{\eta^-} + A_3 V_C^{\beta^-} V_E^{\eta^+} + A_4 V_C^{\beta^-} V_E^{\eta^-} \quad (7)$$

where A_1, A_2, A_3 and A_4 are arbitrary constants while $\beta^+, \beta^-, \eta^+, \eta^-$ are four roots of an elliptical equation which is a two factor counterpart of the one factor stochastic model quadratic equation presented in Dixit & Pindyck (1994). The equation of the corresponding ellipse is given by the following equation (Adkins & Paxson, 2011).

$$\begin{aligned} Q(\beta, \eta) = \frac{1}{2}\sigma_{V_C}^2 \beta(\beta - 1) + \frac{1}{2}\sigma_{V_E}^2 \eta(\eta - 1) + \rho\sigma_{V_C}\sigma_{V_E} \beta\eta + (r - \delta_{V_C})\beta + \\ (r - \delta_{V_E})\eta - r = 0 \end{aligned} \quad (8)$$

The above ellipse is distributed over four Cartesian quadrants with each pair of roots corresponding to one of them each. Hence, considering the absorbing barriers $F_M(0, 0)$ and $F_M(V_C, 0)$; $A_2 = A_4 = 0$, as it is obvious that the option to invest will be worthless if the present value of future cash - flows is zero. Likewise when V_C becomes infinitely large for any value of V_E , the option is as well worthless and the would be better off with his incumbent Job, so to comply with that we set the value of constant $A_1 = 0$, leaving only leaves only one constant $A_3 \neq 0$. Thus, in our case, it's the third quadrant which is of our interest, corresponding to the pair of roots $\{\beta^-, \eta^+\}$.

Moving on, the following equation further reduces equation (7), the general solution to the homogeneous part of the differential equation of Value Function F_M (equation (4)):

$$F_M^H(V_C, V_E) = A_3 V_C^{\beta^-} V_E^{\eta^+} \quad (9)$$

For non-homogeneous part, F_M^{NH} , we propose the following solution:

$$F_M^{NH} = W + \varphi V_C \quad (10)$$

Hence, combining the homogeneous and non-homogeneous part of the solution, we obtain the following expression which satisfies the partial differential equation (4) of value function F_M :

$$F_M^H(V_C, V_E) + F_M^{NH} = F_M(V_C, V_E) = A_3 V_C^{\beta^-} V_E^{\eta^+} + W + \varphi V_C \quad (11)$$

Applying the Value Matching condition, we obtain the following expression:

$$F_M(V_C^*, V_E^*) = A_3 V_C^{*\beta^-} V_E^{*\eta^+} + W + \varphi V_C^* = V_E^* - K \quad (12)$$

where K is the investment cost *Manager* will incur when he takes on *Entrepreneurial* venture.

But the above stated value-matching condition does not support homogeneity of degree one on both sides meaning; $\beta^- + \eta^+ \neq 1$. So, we follow Adkins and Paxson (2011) quasi-analytical solution by constructing a set of four simultaneous equations to take care of the issue. The first equation will be the value matching condition given by equation (12), the second will be the equation of ellipse given by equation (8) and the remaining two are going to be obtained by applying smooth-pasting conditions to equation (12). The first of the two is the first-order derivative of the value-matching condition with respect to V_C^* and after algebraic manipulations, we obtain the first smooth-pasting condition as:

$$A_3(\beta^-) V_C^{*\beta^-} V_E^{*\eta^+} + \varphi V_C^* = 0 \quad (13)$$

The second smooth-pasting condition is the first-order derivative of the value matching condition with respect to V_E^* and likewise after algebraic manipulations we reach the same as:

$$A_3(\eta^+) V_C^{*\beta^-} V_E^{*\eta^+} = V_E^* \quad (14)$$

So using Equation (8), (12), (13) and (14) which form our set of simultaneous equations, we will define the *Manager's* discriminatory boundary given by a set of countless pairs $\{V_C^*, V_E^*\}$. This boundary will demarcate the waiting region from the switching region (to *Entrepreneurship*) for the *Manager* (see Figure 3). Having said that we have five unknowns: $A_3, V_C^*, V_E^*, \beta^-, \eta^+$ with four simultaneous equations. We will set V_C^* as a particular value and determine the corresponding $A_3, V_E^*, \beta^-, \eta^+$. We will repeating the process again and again for different values of V_C^* , hence obtaining a set of pairs $\{V_C^*, V_E^*\}$ that defines the discriminatory boundary for the *Manager*.

4. Numerical Example

Let us now present a numerical example to illustrate the model. Consider the following value of the parameters:

Table 1: The base case parameters

Parameter	Value
K	1000
σ_{V_C}	0.2
σ_{V_E}	0.3
δ_{V_E}	0.02
δ_{V_C}	0.01
r	0.02
W	100
ρ	0.00
φ	0.05

Table 2: The ordered pairs $\{V_C^*, V_E^*\}$ for optimal cash flow from Entrepreneurial Venture, V_E^* for a given cash flow of the company, V_C^* for an incumbent Manager to exercise the Switch option.

	V_C^*					
	12000 ($\varphi V_C=600$)	13000 ($\varphi V_C=650$)	15000 ($\varphi V_C=750$)	20000 ($\varphi V_C=1000$)	25000 ($\varphi V_C=1250$)	30000 ($\varphi V_C=1500$)
V_E^*	7096.47	7324.41	7780.76	8925.3	10073.6	11224.5
A_3	0.133	0.140	0.157	0.199	0.238	0.277
η^+	1.316	1.313	1.312	1.307	1.304	1.301
β^-	-0.112	-0.117	-0.127	-0.147	-0.162	-0.174

Figure 4 illustrates the discriminatory boundary that separates the waiting region from the switching region. This optimal boundary is composed of pairs for V_C^* and V_E^* which divides the region where the *Manager* will continue with his job from the region where he will make

the switch to *Entrepreneurship*. As is evident from Figure 4, there exists a linear relation between relationship between V_C^* and V_E^* . So, for a given cash flow of a company, we have an optimal level of cash flow that must be generated from the *Entrepreneurial Venture* (we are addressing them as ordered pairs: V_C^* and V_E^*) for the *Manager* to exercise his option to switch to *Entrepreneurship*. So, it is optimal for *Manager* to exercise the option when the cash flow from *Entrepreneurial Venture* is sufficiently high than his current compensation (which is dependent on the company's cash flow where he is *Manager*) or his compensation from the incumbent job is too low that possible cash flows from *Entrepreneurship*.

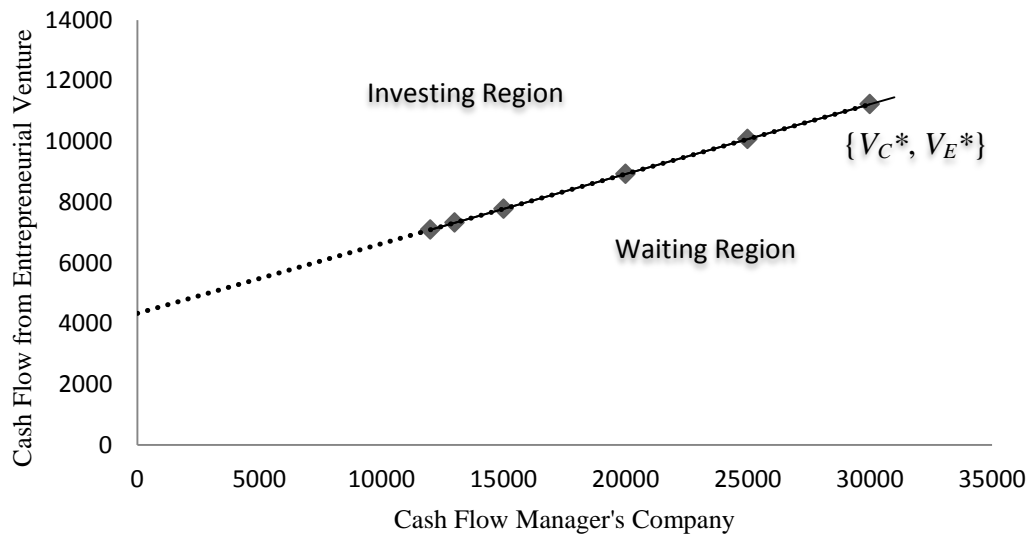


Figure 4: Incumbent Manager's discriminatory boundary.

4.1 Sensitivity Analysis

Assuming the same base case parameter's value in Table 1 with the exception of the one we will vary for the purpose of sensitivity analysis, we are going to analyze how change in volatility of cash flows of the company and from Entrepreneurial Venture respectively and correlation between them impact optimal trigger.

4.1.1 The impact of volatility of Cash flow from the Entrepreneurial Venture on the optimal trigger

Table 3 demonstrates how the possible changes in volatility of cash flow from the *Entrepreneurial* Venture affect the optimal trigger for the *Manager* to exercise his switch option. Results included in the table shows that higher volatility levels lead to higher value of the optimal trigger. If the cash flows from the *Entrepreneurial* Venture are volatile, *Manger* will need high trigger to exercise his option.

Table 3: Sensitivity Analysis: The impact of the volatility of cash flow from the Entrepreneurial Venture, σ_{V_E} on the optimal trigger, V_E^* .

	V_C^*				
	12000	15000	20000	25000	30000
$V_E^* (\sigma_{V_E} = 0.25)$	5835.28	6411.33	7376.64	8346.45	9319.32
$V_E^* (\sigma_{V_E} = 0.3)$	7096.63	7780.76	8925.3	10073.6	11224.5
$V_E^* (\sigma_{V_E} = 0.35)$	8550.72	9360	10715	12072.2	13431.5
$V_E^* (\sigma_{V_E} = 0.4)$	10202	11156.5	12750.2	14346.6	15944.9

4.1.2 The impact of volatility of Cash flow of the Incumbent's Company on the optimal trigger

Table 4 demonstrates how the possible changes in volatility of cash flow of the Incumbent Company affect the optimal trigger for the *Manager* to exercise his switch option. Results included in the table shows that higher volatility levels lead to higher value of the optimal trigger. Given *Manger's* net compensation from the current job depends on the company's cash flows, it makes sense that the more volatile they are, the more opportunity it gives *Manager* for a higher compensation. So, In this regard yet again, for him/her to exercise the switch option, the trigger must be higher.

Table 4: Sensitivity Analysis: The impact of the volatility of cash flow of the incumbent's company's, σ_{V_C} on the optimal trigger, V_E^* .

	V_C^*				
	12000	15000	20000	25000	30000
$V_E^* (\sigma_{V_C} = 0.15)$	6861.53	7482.68	8520.54	9560.73	10602.5
$V_E^* (\sigma_{V_C} = 0.2)$	7096.63	7780.76	8925.3	10073.6	11224.5
$V_E^* (\sigma_{V_C} = 0.25)$	7401.62	8167.44	9450.07	10738	12029.6
$V_E^* (\sigma_{V_C} = 0.3)$	7778.09	8644.61	10097.1	11556.5	13020.5

4.1.3 The impact of the variation in correlation coefficient between the two cash flows on optimal trigger

In our numerical example we have assumed possible correlation between the two cash flows. As can be seen from Table 5, higher is the correlation between the cash flows lower is the trigger and it makes sense because higher correlation signals similar market condition there by reducing the level of uncertainty. Henceforth, the *Manger* would seek lower trigger to exercise the switch option.

Table 5: Sensitivity Analysis: The impact of variation of Correlation Coefficients, ρ on the optimal trigger, V_E^* .

	V_C^*				
	12000	15000	20000	25000	30000
$V_E^* (\rho = -0.5)$	8046.23	8966.15	10500.2	12036.5	13574.1
$V_E^* (\rho = 0)$	7096.47	7780.76	8925.3	10073.6	11224.5
$V_E^* (\rho = 0.5)$	6129	6571.74	7315.32	8064.32	8817.35

5. Conclusion

In this dissertation, we built a model following Adkins and Paxson (2011) and arrived at optimal timing for an incumbent *Manager* to exercise the Option (to take on *Entrepreneurship*) when cash flow from the *Entrepreneurial* Venture and the Company where he employed is uncertain and follow Geometric Brownian Motion which are possibly correlated.

We have emphasized the need for Incumbent *Managers* to take up *Entrepreneurship* as we are of the view that they are better positioned to take the same in the current uncertain economic landscape given their vast experience with the hope that their success would in turn inspire youths to take *Entrepreneurship* and this would help in reviving the slumping economy. We believe such analysis has the potential to give incumbent managers an extra impetus of certainty, encourage them to make an informed shift towards entrepreneurial venture should they wish to do so and eventually benefit society as a whole.

We arrived at the optimal trigger for the *Manager* to exercise the switch option for a given cash flow of the company (We have posited at the beginning that Manager's net compensation depends on Company's cash flow). This discriminatory boundary is represented by a set of pair values of the respective cash flows.

Sensitivity analysis demonstrated that volatility in either of the cash flows lead to increase in the trigger while possible correlation between them brings the trigger down.

Finally, this study can be further adopted to include more or different variables. There are many possibilities. As an example the study has the potential to be readily extended to regarding optimal timing for young adults to take up entrepreneurship. Also, it can be used by the MNC's to draft incentive packages to motivate good managers to stay with the company rather starting up their own.

Bibliography

- Eurostat*. (2011). Retrieved from [http://ec.europa.eu/eurostat/statistics-explained/index.php/Labour_market_and_Labour_force_survey_\(LFS\)_statistics](http://ec.europa.eu/eurostat/statistics-explained/index.php/Labour_market_and_Labour_force_survey_(LFS)_statistics)
- Abell, D. F., & Hammond, J. (1979). *Strategic market planning: Problems and analytical approaches*. Englewood Cliffs, NJ: Prentice Hall.
- Adkins, R., & Paxson, D. (2011). Renewing assets with uncertain revenues and operating costs. *Journal of Financial and Quantitative Analysis* 46.03, 785-813.
- Audretsch, D. (2009). From knowledge to innovation: resolving the — "European Paradox". In *Innovation Imperative: National Innovation Strategies in the Global Economy* (pp. 77 - 91). Massachusetts: Edward Elgar Publishing Limited.
- Audretsch, D. B., & Fritsch, M. (2002). Growth regimes over time and space. *Regional Studies* 36.2, 113-124.
- Constantinides, G. (1978). Market risk adjustment in project valuation. *Journal of Finance*, 33(2).
- Cordoso, D., & Pereira, P. J. (2015). A Compensation Scheme for Optimal Investment Decisions. *Finance Research Letters*.
- De Clercq, D., & Honig, B. (2011). Entrepreneurship as an integrating mechanism for disadvantaged persons. *Entrepreneurship & Regional Development*, 353-372.
- Dixit, A., & Pindyck, R. (1994). *Investment Under Uncertainty*. New Jersey: Princeton University Press.
- Eisenhardt, K. M., & Schoonhoven, C. (1990). Organizational growth: Linking founding team, strategy, and growth among U.S. semiconductor ventures, 1978- 1988. *Administrative Science Quarterly*, 35, 504- 529.
- Foil, C. M., & Lyles. (1985). Organizational Learning. *Academic Management Review*, 803 - 813.
- Huber, G. (1991). Organizational Learning: The Contributing Processes and Literatures. *Organ. Sci.* 2(1), 88–115.

- Lambkin, M. (1988). Order of entry and performance in new market. *Strategic Management Journal*, 9, 127-140.
- Mitchell, W. (1991). Dual clocks: Entry order influences on incumbent and newcomer market share and survival when specialized assets retain their value. . *Strategic Management Journal*, 12, 85–100.
- Nolan, A. (2003). *Entrepreneurship and Local Economic Development*. Paris: OCDE.
- OECD. (2010). *Off to a Good Start, Jobs for Youth, OECD*. Paris: OECD.
- PARENTE, C., SANTOS, M., MARCOS, V., & COSTA, D. (2012). Perspectives of Social Entrepreneurship in Portugal: Comparison and Contrast with International Theoretical Approaches. *International Review of Social Research*, 113-134.
- Pereira, P. J., & Rodrigues, A. (2014). Investment Decisions in Finite Lived Monopolies. *Journal of Economic Dynamics and Control*, 219-236.
- Porter, M. E. (1990). The Competitive Advantage of Nations. *Harvard business review* 68.2, 73-93.
- Robinson,, W. T., & Min, S. (2002). Is the first to market the first to fail? Empirical evidence for industrial goods business. *Journal of Marketing Research*, 39(1), 120 - 129.
- Rothaermel, F. T. (2001). Incumbent's advantage through exploiting complementary assets via interfirm cooperation. *Strategic Management Journal*, 22, 687 - 699.
- Storey, D. J., & Francis, G. J. (2010). *Small business and entrepreneurship*. Financial Times Prentice Hall.
- Szymanski,, D. M., Troy, L. C., & Bharadwaj, S. G. (1995). Order of entry and business performance: An empirical synthesis and reexamination. . *Journal of Marketing*, 59, 17–33.
- Trigeorgis, L., Brosch, R., & Smit, H. (2010). *Stay Loose*. Dow Jones & Company.